Project Introduction

Clear Science Corp. and Duke University propose to develop and demonstrate a new and efficient computational method of modeling nonlinear aeroelastic systems. The method will extend the scope of multi-disciplinary computational tools like NASA Dryden's STARS by augmenting linear eigenmode stability algorithms and coupled time-marching techniques. The objective is a low-dimensional model that accurately reflects nonlinearity in both structure and fluid and that is efficient enough to permit full exploration of parameter space. In Phase I, our team will evaluate two types of model order reduction: proper orthogonal decomposition of the coupled-system variables and the method of harmonic balancing. We will downselect one method based on efficiency, accuracy, and versatility, demonstrate its merit via a prototype problem, and design a comprehensive Phase II plan for model development and testing. The proposed innovation can minimize the risk of failure and maximize flight safety in aircraft like the F-18-AAW and X-43 by accurately and efficiently predicting nonlinear dynamics over a broad range of flight conditions. Integrating the nonlinear model with codes like STARS will augment the capability of quickly determining linear stability with the capability of efficiently analyzing nonlinear behavior like limit cycle oscillations, hysteresis, higher harmonic and sub-harmonic resonances, jump resonances, entrainment, beating, and period doubling.

Primary U.S. Work Locations and Key Partners
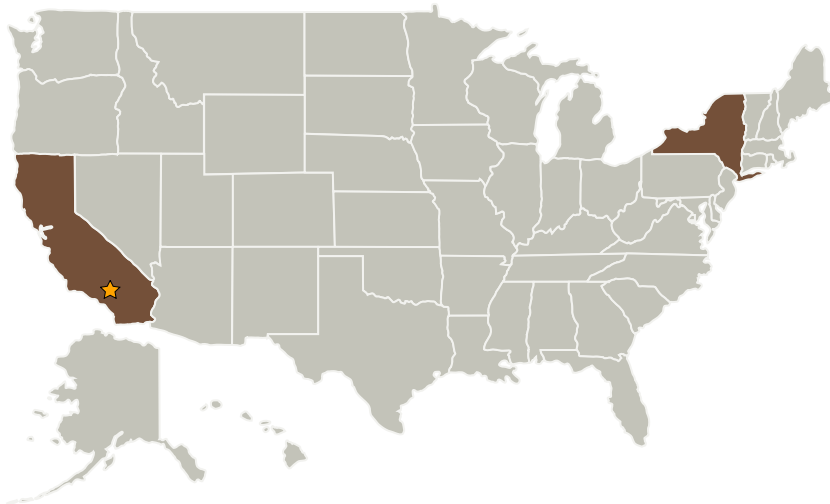

Computational Models for Nonlinear Aeroelastic Systems, Phase I

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Organizations Performing Work	Role	Type	Location
⭐Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California
Clear Science Corporation	Supporting Organization	Industry	Harford, New York

Primary U.S. Work Locations	
California	New York

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Henry A Carlson

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  └ TX15.1 Aerosciences
    └ TX15.1.3 Aeroelasticity